

further amendments are necessary to satisfy the Examiner's requirements, the undersigned would welcome a telephone interview at which the Examiner may specify additional changes he would like to make to this application, and give his reasons for those requirements.

B. Response to Detailed Grounds for Rejection

At page 2, the Examiner has objected to the claims under 35 U.S.C. §112, first and second paragraphs. The grounds for rejection will be discussed in turn.

The Examiner objected to the terms "a commutator," "the motor," "the same time" in claims 6, 7 and 15. These claims have been amended to satisfy the Examiner's requirements.

The Examiner said that the phrase "said first and second support arms" in claims 10-14 has "no antecedent basis." That phrase finds antecedent support in lines 3-4 of claim 7. It is also noted that the phrase "said first and second support arms" does not appear in claim 14. Therefore, this objection to claims 10-14 is requested to be withdrawn.

The Examiner objected to the phrase "said third and fourth support arms" in claims 15, 16, 37 and 39. The phrase in claims 16 and 37 finds antecedent basis in lines 2-3 of claim 15. Therefore, the objection to claims 15, 16 and 37 is requested to be withdrawn. The phrase "third and fourth support arms" does not appear in claim 39. Therefore, the objection to this claim should be withdrawn as well.

The Examiner objected to "said first support" and "said second support" in independent claims 17 and 33. The rejection is respectfully traversed. There is nothing of record to indicate in any way that these terms lack any type of antecedent basis or are unclear to an individual having ordinary skill in this art in the context of this patent application. The Examiner also objected to "said first support" in claims 24 and 28, which phrase has antecedent basis in claim 17 and is therefore submitted to be in proper form. The Examiner's objection to "said first and second supports" in claim 38 is also respectfully

traversed. Claim 38 depends from claim 17 which explicitly provides antecedent basis for the first and second supports at lines 3-4.

The Examiner stated that "said different resonance frequencies" in claim 42 has no antecedent basis. The claim is not believed to require amendment. That phrase appears at lines 11-12 and is supported by the preceding lines 8-9. Further, the word "natural" is being deleted from line 8, not to change the substance of the claim, but in an attempt to understand and satisfy the Examiner's particular requirements.

The Examiner stated at lines 13-18 on page 2 of the Office Action, that several phrases are insufficiently supported in the specification. See page 3, lines 9 and 19; page 4, line 13; and page 5, line 1. The specification has been amended to correspond with the claim language the Examiner has pointed out. Therefore, the rejection of these particular claims is now requested to be withdrawn. In particular, the phrases "plurality of circumferential segments . . . the support arms being connected electrically in parallel" in claim 7, "an aperture" in claim 13, "third and fourth support arms" in claims 15, 16, 37 and 39, "third and fourth brush bodies" in claims 15, 34 and 37, and "third and fourth brushes" in claim 38, are supported in the specification.

II. Response to Objection to Specification
Under 35 U.S.C. §112, First Paragraph

At page 3 of the Office Action, the Examiner objected to the specification and rejected the claims under 35 U.S.C. 112, first paragraph.

A. There is No New Matter Rejection

Although at page 3, line 19, the Office Action refers to "new matter," there is no rejection of any of the claims under 35 U.S.C. §132. It is therefore concluded that the Examiner does not consider the amendment to enter new matter into the disclosure as prohibited by 35 U.S.C. §132.

B. Response

The Examiner has objected to the alleged lack of word-for-word correspondence between the specification and certain phrases in claims 19, 20, 22, 23, 33, 37 and 38-40. See page 3, lines 4-22 of the Office Action. The Examiner has further objected to the specification and rejected claims 19-23, and 37-40 under 35 U.S.C. §112, first paragraph.

As mentioned above, the specification has been amended to satisfy the Examiner regarding support in the specification for certain claim features mentioned on page 2 of the Office Action at lines 13-19. These amendments to the specification may obviate some of the Examiner's objections and rejections on page 3 of the Office Action.

In addition, it is submitted that the features of claims 20 and 23 are fully supported by the specification at page 3, line 11, in view of Figs. 1 and 2 and the general state of the art regarding the normal operation of a DC motor. The features in claim 22 are supported by the specification as amended at page 3, line 19, which indicates that the supporting parts 18, 19 and the brushes 20, 21 on the left side of Fig. 2 will be referred to as "first" and "second," while the corresponding elements on the right side of Fig. 2 will be referred to as "third" and "fourth." Claim 22 is supported by, for example, page 2, lines 4-7, which states that the separate arms in each pair of arms it may be arranged to have different natural resonance frequencies of oscillation. The feature of claim 33 is supported by amended page 4, line 21, which in turn is supported by Fig. 3. The features recited in claims 37-40 are supported in the specification, for example, at page 5, lines 3-7 and 17-21.

For all these reasons, the objections to the specification and claim rejections on page 3 under 35 U.S.C. §112, first paragraph, are now requested to be withdrawn.

III. Prior Art Rejections

A. Brief Summary of the Invention

As already well explained in the specification, the invention provides a brush assembly for a DC electric motor in which the brush-commutator interface resistance may be reduced because of a new, advantageous feature not seen in the prior art; namely, a brush assembly in which a pair of brushes are provided in parallel, axially along the length of the commutator. They are disposed for contacting the commutator simultaneously, that is, they are adjacent the same given segment of the commutator. It has previously been known to provide a pair of brushes in parallel at the same circumferential point around the commutator, as shown for example in Watanabe U.S. Patent 4,086,510. However, to obtain the advantageous features just mentioned, the resonant frequency of the respective brushes are made different. Thus, even if there is some bouncing of the brushes with respect to the commutator, the bouncing of the two respective brushes will occur at different points in time due to their different resonant frequencies, resulting in at least one brush being in contact with the commutator at all times. Thus the brush-commutator interface electrical resistance is reduced, improving current conduction.

The different resonant frequencies of the brushes are obtained in different ways. The brushes may have different weights or densities. Slots, apertures, or narrow portions may be formed in the brush arms. Various claims are directed to different structures that provide the different resonant frequencies.

As also disclosed the specification, there may be a second pair of brushes diametrically opposite the first pair of brushes. These would be termed "third and fourth brushes" in some of the claims, and they are supported on "third and fourth support arms." Again, it is highly advantageous for the third and fourth brushes to have different resonant frequencies in combination with their respective support arms. Again, the third and fourth brushes are disposed axially along the commutator so

they are capable of simultaneously contacting a single respective segment of the commutator.

B. Rejection Over Baines and Muller

Claims 5-7, 9-14, 17-20, 24-33 and 40-42 have been rejected as being obvious over either Baines in view of Muller, or Muller alone.

1. Summary of Argument

In the Office Action, in the paragraph running from page 5 to page 6, the Examiner responds to the arguments filed in the most recent amendments in this case. There is nothing in the Examiner's response to support the conclusion that the prior art suggests a pair of brush arms and brushes, longitudinally spaced along a commutator of a DC motor, having different respective natural resonance frequencies of oscillation.

The Examiner argues Muller teaches different resonance frequencies, but that is irrelevant because Muller's "arms" are on opposite sides of the rotating surface they contact. They are not "axially spaced from each other with respect to a longitudinal axis of a DC motor" as recited in the present claims, for example claim 7.

Baines does not supplement the Examiner's argument, because as stated in the Office Action dated April 14, 1992, Baines does not teach any support arms and brushes having different resonant frequencies. None of the references including Baines are concerned with the provision of two or more brush contacts for electrical engagement with a rotating cylindrical body such as a commutator or a slip ring for the purpose of supplying an electric motor with higher current without increasing current density at the interface between the stationary contacts and the rotating cylindrical body. Thus, the objects of the present invention, the problems it solves and the solutions thereto, are neither disclosed nor suggested by Baines, individually or in combination with the other references.

The Examiner also pointed out that the contact points of the wiper arms taught by Muller are not diametrically opposite to each other. That is correct. Diametrically opposite contact points may be suggested in Baines' Fig. 1, but that reference does not suggest the different resonance frequencies of axially spaced brush assemblies recited in each of the present claims. The Examiner has pointed out additional references that are said to relate to third and fourth brushes, such as Watanabe and Hargreaves, but those references neither disclose nor suggest the feature of different resonance frequencies of first and second brush assemblies. Therefore, even the Examiner's supplemental arguments in this Office Action do not support a rejection of the present claims.

2. Muller's Teachings Are Irrelevant to This Invention

The Examiner cited Muller (Fig. 3) as teaching wiper arms, which, in his view, are analogous to brushes and support arms for brushes in a motor. The Muller reference states that the wiper arms have different resonant frequencies. Therefore, in the Examiner's view, it is obvious to modify the brushes in the primary references, so as to have different resonant frequencies.

The Muller reference is irrelevant to the claimed invention. Muller was concerned with solving a different problem than that solved by the present invention.

Claims 7 and 18, and 33 specify that the first and second supports or support arms are mounted so as to be spaced axially with respect to the rotating commutator at the axis of the motor.

The problem to be solved is keeping at least one of the first and second axially-spaced brushes in good contact with the given commutator portion at a given time. With the invention, since the first and second support/brush combinations have different resonant frequencies, then even if the commutator is somewhat irregular and the brushes are bouncing along its surface, they will not be bouncing at the same frequency and

therefore one of the brushes will most likely be in contact with a given circumferential portion of the commutator at a given time, which is highly advantageous for maintaining proper operation of the motor.

There is no such axial spacing of the wiper arms in Muller. Muller never considered the problems of maintaining axially spaced brushes in contact with a motor commutator. Therefore, Muller cannot disclose any relevant teachings for solving that problem.

Further, claims 7, 15, 17, 19-20 and 23 specify that the claimed first and second (or third and fourth) brushes are for contacting the same circumferential segment or region of the commutator, that is, for contacting the commutator at substantially the same position around its circumference. In Muller, the two wiper arms are not at the same circumferential location around the rotating shaft. (They are not even at opposite locations on the shaft.)

Even if Muller were combined with other references, for example with the Baines reference as the Examiner has proposed, such a combination would not have the features now claimed. In such a combination, the first and second brush/support arm combinations might well have the same resonant frequency, contrary to the express requirements of claims 7, 17, and 33 and the dependent claims. Muller's teachings at most relate to wiper arms which engage different circumferential portions of a rotating shaft. Muller teaches nothing about wiper arms or motor brushes in the arrangement of claims 7, 17, and 33. If Muller were combined with the primary references, even assuming such a combination were proper, Muller would teach at most that a brush on one side of a motor commutator should have a different resonant frequency from that of a brush on another side of the commutator. In the arrangement set forth in the independent claims, this would mean that the first and second brushes might well have the same frequency as each other. Such a result is not ruled out by Muller.

If there were third or fourth brushes on a different side of the commutator from the first and second brushes, the third and fourth brushes would also have the same frequency as each other. The limit of Muller's teachings, for the sake of argument, is that the frequency of the third and fourth brushes should be different from that of the frequency of the first and second brushes.

Furthermore, Muller does not even teach a relationship for resonant frequencies of wiper arms on diametrically opposite sides of a rotating shaft. As clearly shown in Fig. 3 of Muller, according to basic trigonometry, the contact points of the wiper arms on the rotating shafts will not be diametrically opposite to each other, but will both be slightly displaced in the direction toward the left as shown in Fig. 3 of Muller.

For at least the above reasons, the Muller reference, even in combination with the primary references, neither discloses nor suggests the invention as now claimed. An alternate ground for rejection was based on the Muller reference alone. That rejection is respectfully traversed for the reasons already discussed.

3. Muller's Frequency-Setting Technique Teaches Away from the Invention

The different resonant frequencies in Muller are obtained by providing the wiper arms with different lengths. Even assuming that Muller could be combined with the primary references, nothing in Muller can suggest the features of claim 33, which specifies that the first and second support arms have substantially the same length. In fact, Muller teaches away from this invention.

Nor can Muller suggest the subject matter of claims 5, 6, 8-13, and 24-31, which state that the different resonant frequencies of the support/brush combinations are obtained by different shapes or sizes or densities of the brush, or different resiliencies of the support, which are obtained, for example, by

providing a slot or a different dimension of at least one of the supports.

Nor can Muller suggest claims 24-31, which specify that at least one of the first brush and the first support has adjusting means for causing the first frequency to be different from the second frequency. Even if the features of the prior art resulted in particular frequencies as the Examiner has alleged, the prior art suggests no such "adjusting means" as claimed.

Claims 34 and 35 depend respectively from claims 15 and 21. Each of these dependent claims specifies that the third and fourth brushes or brush bodies are substantially diametrically opposite the first and second brushes or brush bodies with respect to the motor axis. Such a relationship is not taught or suggested by the Muller reference. As clearly shown in Fig. 3 of Muller, the contact points of the wiper arms and rotating shaft are not diametrically opposite to each other, but rather, both contact points are slightly displaced in the direction toward the left as seen in Muller's Fig. 3.

Claims 36-40 depend respectively from claims 7, 16, 17, 22 and 33, and recite specifically that the different resonant frequencies of the brushes and support arms recited in the independent claims enable the two brushes to provide reliable electrical contact between the support arms and the commutator, by reducing the interface resistance between the brush bodies and the commutator, despite oscillations of the arms and brushes that occur in response to rotation of the commutator. This feature is supported, for example, at pages 1 and 5-6 of the specification. No such feature is seen to be either disclosed or suggested by the prior art.

4. Muller's Teachings as to Wiper Arm Length Are Irrelevant to the Invention

Further, the teachings of Muller are not significant in the field of brushes for a DC motor. The natural frequency of the brush/support combination is essentially determined by the resiliency of the support and/or the weight of the brush. The

weight of the brush is by far the most significant part of the overall weight of the support arm together with the brush. Adjusting the length of the support arm would have very little practical effect. The natural resonant frequency of the brush/support arm combination would be virtually unaltered by having different arm lengths, bearing in mind that the support arms are supported at substantially the same radial distance from the axis of the motor.

In other words, in the context of a DC motor, a resilient support arm pressing a brush body against a commutator is much more dependent for its natural frequency on the actual flexibility of the arm and the actual weight of the brush, than on the length of the arm itself. The solution proposed by Muller would be essentially useless in the context of a dc motor, and in fact is not employed according to the present invention, as defined in the claims.

The only reason Muller would have any practical applicability, if it does, is that its wiper arms do not have relatively heavy brush bodies at their ends.

Thus, the Muller reference teaches away from the solution claimed in claim 33, which specifies that the support arms have substantially the same length. The Muller reference teaches, at most, setting natural frequencies by providing Muller's wiper arms with different lengths.

It also teaches away from the invention of claims 7 and 17 which includes a support and a brush, because Muller's arrangement would be useless for its intended purposes if a relatively heavy brush were somehow grafted onto Muller's wiper arms.

Thus, a skilled individual, reviewing the Muller reference, would discount the Muller reference, since it teaches a useless solution in the context of a DC motor.

5. Muller and Baines are not Combinable as Proposed by the Examiner

Of the prior art relied on most heavily by the Examiner, Baines (U.S. 4,728,835), and Muller (U.S. 3,671,791), neither reference is concerned with the provision of two or more brush contacts for electrical engagement with a rotating cylindrical body, such as a commutator or a slip ring, for the purpose of supplying an electric motor with higher current without increasing current density at the interface between the stationary contacts and the rotating cylindrical body.

Although Muller discloses the use of a wiper member 13 having two contact arms 6, the purpose of the wiper member 13 is merely to provide an electrical connection between a fixed contact pin 5 and the rotating slip ring 7 of a function generator. The provision of the wiper member 13 with two arms is solely for the purpose of providing the wiper member 13 with a "U-shaped end portion" (see line 10, column 1) which (as explained at lines 50 to 54, column 2) can be formed into a C-shaped end 14 for attaching the wiper member 13 to the pin 5. As the wiper member 13 is merely required to engage the slip ring 7 of a function generator 8, there is no disclosure of any advantage to be obtained in providing multiple brushes for reducing current density at the interface between the wiper member 13 and the slip ring 7, as in the present invention.

In fact, the assembly disclosed by Muller will function perfectly well even when the wiper member 13 has only one leg engaging the slip ring 7. This is clear from the disclosure at lines 27 to 31, column 2, where it is explained that the additional use of solder to fasten the wiper member 13 to the pin 5 improves operation even "if one arm breaks" so that the only engagement is provided by the other arm.

For these reasons, there is no motivation in either the prior art or the present application for a combination of Muller and Baines as suggested by the Examiner.

For at least these reasons, the rejection of the foregoing claims is requested to be withdrawn.

6. Rejection Over Secondary References

Claims 15, 16, 21-23 and 34-39 were rejected over the foregoing references and further in view of Watanabe and Hargreaves.

It is respectfully submitted that neither Watanabe nor Hargreaves adds anything to the primary references.

The citation of Hargreaves, Fig. 7, is respectfully traversed. Nothing of relevance is seen in the Hargreaves reference.

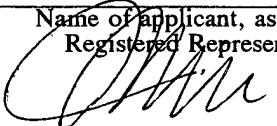
Watanabe merely discloses a known type of brush assembly, already discussed above.

IV. Conclusion

For all the above reasons, the Examiner is requested to allow the claims and pass this case to issue.

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Name of Applicant, assignee or
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Signature
November 15, 1993
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Respectfully submitted,



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